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(54) Titre : PROCEDE DE REVALORISATION DE PIECES METALLIQUES CONTAMINEES PAR DE L'URANIUM
(54) Title: METHOD OF REPROCESSING METAL PARTS CONTAMINATED WITH URANIUM

(57) Abrégé/Abstract:
The invention relates to a method for reprocessing metal parts that are radioactively contaminated with uranium. The metal parts are smelted so that a melt and slag form. U_{235}-depleted uranium is admixed with the metal parts, the melt and/or the slag. It is contemplated that the U_{235}-depleted uranium is admixed in the form of uranium glass.

ABSTRACT

METHOD OF REPROCESSING METAL PARTS CONTAMINATED WITH URANIUM

The invention relates to a method for reprocessing metal parts that are radioactively contaminated with uranium. The metal parts are smelted so that a melt and slag form. U_{235}-depleted uranium is admixed with the metal parts, the melt and/or the slag. It is contemplated that the U_{235}-depleted uranium is admixed in the form of uranium glass.

Drawing

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METHOD OF REPROCESSING METAL PARTS CONTAMINATED WITH URANIUM

The invention relates to a method for reprocessing metal parts that are radioactively contaminated with uranium, wherein the metal parts are smelted to form a melt and slag, and wherein U_{235}-depleted uranium is admixed with the metal parts and/or the melt and/or the still-unsolidified slag.

In dismantiling and also in operation of nuclear plants, large amounts of contaminated metal scrap are produced, which must be eliminated or reprocessed. It is usual to subject this scrap to so-called smelting decontamination. In it, the metal is smelted. Some radioactive substances that cause the decontamination, and that before smelting were located on the surface of the metal parts, are incorporated into the slag formed during the smelting decontamination process. The melt that also forms, whose volume is markedly greater than the volume of the slag, remains largely free of radioactive substances.

As a rule, the slag must be classified as radioactive waste containing nuclear fuel, whose handling and disposal require particular safety precautions. If the contamination was caused by uranium nuclear fuel, which contains 3.1% U_{235}, for instance, then smelting decontamination can be employed only

to a limited extent if more than about 3 g of U_{235} per hundred kg of slag can be expected. As a rule this limit value is exceeded, unless additional precautions are taken, since in the smelting process the uranium moves into the slag and becomes concentrated there.

Exceeding of the limit value could be avoided by admixing some other slag that contains no uranium with the slag that does contain uranium. With a large enough amount of uranium-free slag, the uranium concentration could be decreased to the necessary extent. However, so much slag would be required that the total amount of slag would be increased to an uneconomical extent. Markedly more slag than before would have to be reprocessed.

A method has also already been proposed that contemplates renaturing of the uranium that causes the contamination. It happens that the isotope composition of the uranium that is to be incorporated into the slag or is already incorporated in the slag is altered in such a way as to correspond to the isotope composition of the natural uranium. This means that the proportion of U_{235} must be no greater than about 0.7%. Uranium that is equivalent in its isotope composition to natural uranium does not have to be subjected to the safety regulations that apply to uranium nuclear fuel.

It is already known that to reduce the proportion of U_{235} isotope, U_{235}-depleted uranium is admixed with the metal

parts, the melt and/or the still-unsolidified slag. As a result, once the method is performed, a slag is obtained that incorporates uranium whose proportion of U_{235} isotope is equivalent to the proportion of U_{235} isotope of natural uranium, or even below it.

Until now, it was usual to admix the U_{235}-depleted uranium in the form of UO_2 or U_3O_8. These oxides are in powder form. Experience has shown that such a powder does not distribute uniformly in the melt or the slag. Consequently, it can happen that a slag sample may not have the desired low proportion of U_{235} isotope. When this powder is admixed, dust gets into the ambient air. The dust must then be removed by filters in order to protect the workers.

The object of the invention was to disclose a method for reprocessing metal parts contaminated radioactively by uranium, with which reliable, complete renaturing of the uranium is possible so that then the resultant slag is simple to handle and dispose of.

This object is attained in accordance with the invention in that the U_{235}-depleted uranium is admixed in the form of uranium glass.

In accordance with the present invention there is provided a method of reprocessing metal parts that are radioactively contaminated with uranium, wherein the metal parts are smelted to form a melt and slag, and wherein U_{235}-depleted uranium is admixed with at least one of the metal parts, the melt, and the still-unsolidified slag, characterized in that the U_{235}-depleted uranium is admixed in the form of uranium glass, that takes the form of at least one of granules, beads, rods and pieces.

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The advantage is thus attained that during the smelting decontamination process, the U_{235}-depleted uranium can be mixed homogeneously with the uranium that has caused the

contamination. The same advantage is attained if the uranium glass, which contains the U_{235}-depleted uranium, is admixed with the still- untreated metal scrap and/or with the melt and/or the still- liquid slag, if the slag has already been separated from the remainder of the melt.

By means of the homogeneous mixing and incorporation of the uranium from the uranium glass, the advantage is attained that the isotope composition of the uranium in the slag is likewise homogeneous. There can be no individual zones in the slag that have an overly high U_{235} concentration. Consequently, there is no need for all the slag to be handled like fuel that contains nuclear waste, since the proportion of uranium, in terms of its isotope composition, in the slag corresponds to the natural uranium. The slag can advantageously be handled and disposed of in a simple way.

The U_{235}-depleted uranium is admixed for instance in the form of uranium glass granules, uranium glass beads, uranium glass rods, and/or uranium glass pieces. Such parts comprising uranium glass can be produced by known methods and kept on hand.

For example, a uranium glass that melts at low temperature is admixed. It happens that the uranium glass is a glass of low viscosity at the melting temperature of the metal of the metal parts. This has the advantage that an improved liquefication of slag is attained solely by means of the glass, regardless

of its proportion of uranium. This then leads to still better homogeneous distribution of the admixed uranium.

For example, uranium glass of the alkali oxide/SiO_2/UO_2 type is admixed. Such a glass may contain 50% uranium. The alkali oxide may be Na_2O, for instance.

For example, uranium glass whose uranium has a proportion of U_{235} isotope below 0.7%, for example approximately 0.2%, is admixed. Given an adequate addition, one entertains a proportion of U_{235} isotope in the slag that is advantageously so low that the slag can be disposed of without problems. If the proportion of U_{235} isotope of the uranium that has caused the contamination should amount to 3.1%, for example, then with uranium glass whose proportion of U_{235} isotope is 0.2%, a proportion of U_{235} isotope in the slag that is less than 0.7% is attained.

For example, uranium glass that contains less than 50% uranium is admixed. In particular, the uranium glass contains less than 40% uranium, for instance between 5% and 15%. The density of a uranium glass is lower if the proportion of uranium in the glass is lower. If the proportion of uranium in the uranium glass is markedly lower than 50%, a uranium-containing slag is formed whose density is markedly lower than the density of the iron- containing melt. As a result, the slag floats on the melt and can be separated especially easily from the melt, for example being ladled off. The density of

uranium glass having a uranium proportion of 10%, for instance, is 3.5 g/cm^3. For a uranium proportion of 50%, the density of the uranium glass is 7.7 g/cm^3. The density of iron is about 7.8 g/cm^3.

It will be explained below in terms of an example how much uranium glass is needed for the method of the invention:

In smelting decontamination of contaminated metal parts, 55.4 kg of slag have been formed, which contain 69.25 g of U_{238} and 2.21 g of U_{235}. This corresponds to a proportion of U_{235} isotope of 3.09%. For renaturing, the proportion of U_{235} isotope of 3.09% is to be lowered to 0.5%. This proportion is below the proportion of U_{235} isotope of natural uranium. In order to attain the desired lowering, U_{235}-depleted uranium is used. The proportion of U_{235} isotope of this depleted uranium is 0.2%, for instance. Of this depleted uranium, 620 g are required in order to obtain a slag having a proportion of U_{235} isotope of 0.5%.

In the method of the invention, the depleted uranium is admixed in the form of uranium glass. By way of example, this uranium glass contains 10% of uranium, whose proportion of U_{235} isotope is 0.2%. Then, advantageously, only 6.2 kg of glass are needed so as to lower the proportion of U_{235} isotope of 55.4 kg of slag enough that the slag is easy to handle and can be stored and disposed of with simple means.

With the method of the invention, the advantage is attained in particular that the slag, which contains uranium, occurring in smelting decontamination is easy to dispose of. Exposure to workers and a burden of uranium dust in dust filters are largely averted.

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CLAIMS:

1. A method of reprocessing metal parts that are radioactively contaminated with uranium, wherein the metal parts are smelted to form a melt and slag, and wherein U_{235} - depleted uranium is admixed with at least one of the metal parts, the melt, and the still - unsolidfied slag, characterized in that the U_{235} - depleted uranium is admixed in the form of uranium glass, that takes the form of at least one of granules, beads, rods and pieces.

2. The method of claim 1 characterized in that the uranium glass is a glass of low viscosity at the melting temperature of the metal of the metal parts.

3. The method of any one of claims 1 or 2 characterized in that the uranium glass is a glass of the alkali oxide/SiO_2/UO_2 type.

4. The method of any one of claims 1, 2 or 3 characterized in that the U_{235} isotope proportion in the uranium of the uranium glass is below 0.7%.

5. The method of any one of claims 1, 2, 3 or 4 characterized in that the uranium proportion in the uranium glass is less than 50%.

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